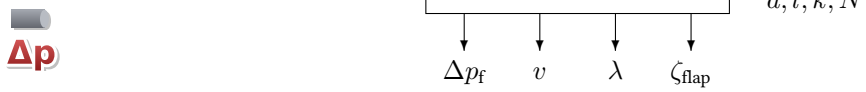
Block DPTUBE

The DPTUBE block calculates the pressure drop in a tube due to friction of an incompressible one-phase turbulent tubular flow from the empirical Colebrook-White equation. It is possible to include a flap in the tube.



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Inputs

1 Volume flow $\dot{V}$ / $m^3\,h^{-1}$
2 Air temperature T / °C
3 Flap angle δ / ° (Open: $\delta = 0°$. Closed: $\delta = 90°$)

Outputs

1 Pressure drop Δp_f / Pa
2 Flow velocity v / $m\,s^{-1}$
3 Tube friction number λ / $m\,s^{-1}$
4 Zeta value of flap position ζ_{flap}

Parameters

1 Nominal tube diameter d / m
2 Length l / m
3 Tube roughness k / mm
4 Number of flaps N (either zero or one)

Strings

None

Tube type	Roughness k / mm
Smooth tubes (brass etc.)	0.0015
PVC and PE tubes	0.007
Asbestos-cement tubes (new)	0.05 . . . 0.1
Steel tubes	0.045
Galvanised steel tubes	0.15
Steel tubes, light rust	0.15 . . . 1.0
Steel tubes, heavy rust	1.0 . . . 3.0
Cast iron tubes	0.4 . . . 0.6
Cast iron tubes, asphaltic	0.125
Sheet metal channel, weltet	0.15
Flexible tubes	0.6 . . . 0.8 . . . > 2.0
Stonewalled channels	3.0 . . . 5.0
Wooden channels	0.2 . . . 1.0
Concrete channels, rough	1.0 . . . 3.0

Table 1: Surface roughness of different tubes according to Recknagel.

Description

The empirical Colebrook-White equation is given by

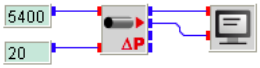
$$\frac{1}{\lambda} = -2 \log \left(\frac{2.51}{\mathrm{Re}\sqrt{\lambda}} + \frac{k}{3.71\, d} \right)$$

where λ denotes the tube friction coefficient, k the surface roughness of the tube, d the nominal tube diameter, and Re the Reynold's number $\mathrm{Re} = vd/\nu$ with the flow velocity v and the viscosity of air ν. Hence, λ is a function of the Reynold's number and the relative surface rougness $\epsilon = k/d$. Some typical k-values are given in Table.

The pressure drop as function of tube length L and air density ρ is given by

$$\Delta p = \lambda \, \frac{L}{d} \, \rho \, \frac{v^2}{2}$$

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A tube with length 1 m and a diameter of 0.35 m is simulated with a tube roughness set to 0.15. No flap is assumed. The volume flow is set to 5400 m^3/h at an air temperature of 20 °C as defined through two CONST blocks. The SCREEN block displays the pressure drop and the flow velocity.

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7.241074 15.590689
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